Progress Report

Grant #731009
Ultra-Efficient Generators & Diesel Electric Propulsion
Genesis Machining & Fabrication
Reporting Dates: 7/2014-9/2014

Deliverables Submitted:

No deliverables scheduled at this time.

Budget:

We are invoicing for $8,750.00 for labor, $39,506.84 for materials, equipment and other expenses. We are requesting $4,375.00 in advance for labor for the October - December quarter of 2014. Finally, we are submitting $ 31,669.93 in match.

Schedule Status:

We continue to be a little behind schedule because of the delays incurred earlier this year waiting for the diesel power unit and design software.

Work Progress:

1. Electronics design and assembly workspace

We spent a few weeks this quarter building a new workspace for designing, building, and testing electronics. Previously our main workspace was our machine shop which was inadequate for electronics work. Now we have a lab for electronics which will suffice for our pre-commercial work.

Figure 1 - New Electronics Lab

2. TRL-7 Battery Management

A critical feature in high efficiency power generation is energy storage. While not all generator installations require storage, it is a great benefit because it allows generators to operation at their overall peak efficiency point, assists in load starting capability, and can keep the power on when the generator is down for maintenance. During the first part of this grant we built a prototype lithium iron phosphate battery pack for our electric vehicle test-bed. Based on our original research we decided that the pack only needed occasional balancing and did not need real-time monitoring and management. However, subsequent research and discussions with industry specialists revealed that this was incorrect. $LiFePO_4$ cells do require management for safe operation. Having learned this we took the opportunity to develop a battery management system for these cells. This was critical for us because our current battery pack would be useless without it, and we are also planning on building and installing a pack into our diesel-electric bus design. We are therefore considering the TRL-7 Battery Management System (BMS) to be a necessary design feature of our TRL-7 work. During this quarter we successfully designed, printed, tested, and assembled the TRL-7 BMS. We have some programming left to do and need to install the system into the EV test-bed. This board, because of its relative simplicity, was a good starting place for us using our new design software and fabrication tools.

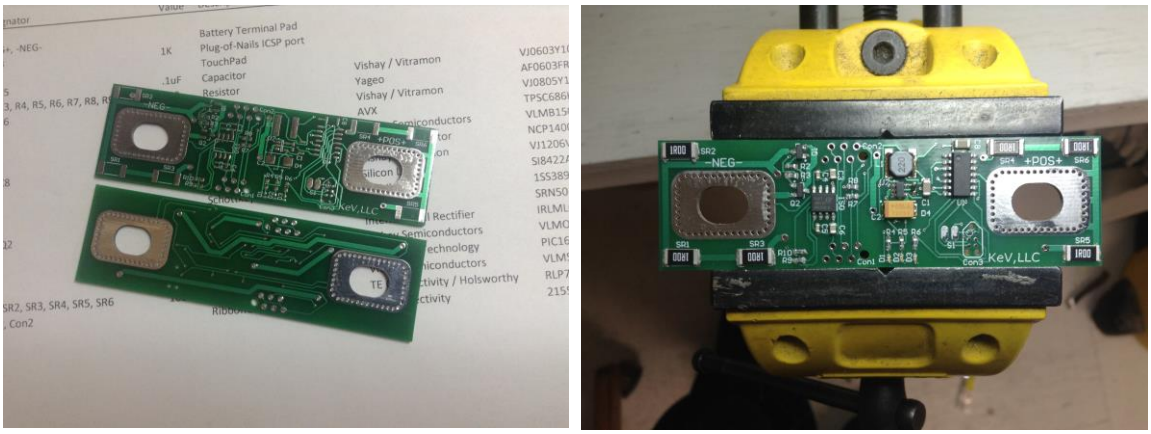

Figure 2 - Prototype BMS PCB (Left). Assembled prototype (Right)

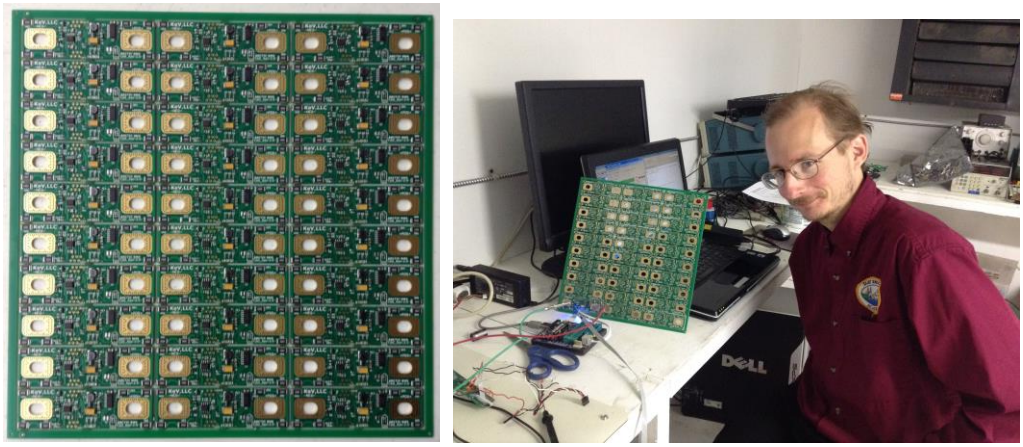

Figure 3 – Panelized and assembled TRL-7 BMS boards (Left) Seraphim McGann with working board. (Right)

3. TRL-7 Design

We have made a great deal of progress with the printed circuit board designs for our TRL-7 inverter modules but have not yet printed any boards. Considerable time has been spent designing the high speed bus which interconnects our inverter modules. Time was also spent designing board stack-up, impedance matching, and differential pair routing. In addition to continued PCB design on the TRL-7 inverters, we have also purchased all third party hardware needed to build these modules.

4. Fabrication Technology

A large part of PCB prototyping cost and time is wrapped up with board assembly. To overcome this limitation we purchased a low-cost pick-and-place machine last quarter. We have had excellent success with this machine and have already saved thousands of dollars using it to assemble our TRL-7 BMS boards. We look forward to continue using it this quarter to assemble our inverter boards. Videos of this machine assembling our boards can be seen here:

https://www.youtube.com/watch?v=H08SmZGS_Is&feature=youtu.be

https://www.youtube.com/watch?v=9SuMXowwb6w

5. Intellectual Property: Patents Pending! (almost…)

During this quarter we have had the good fortune to meet Jack Jmaev, an electrical engineering patent attorney who is also an entrepreneur with his own start-up company. We signed a retainer agreement with Mr. Jmaev for two patents on our technology: one regarding the generator, and one regarding the inverter. Jack visited us in Kodiak for three days to work out the details for our patents and to give us a quick course in soliciting start-up investment. Our patents should be filed within the next couple of weeks.

6. Business Plan

We have begun the process of developing a concrete business plan and we are currently studying some local possibilities for a pilot project.

Work for Next Quarter

1) Design, print, assemble and test TRL-7 PCB designs.
2) Install TRL-7 BMS into EV testbed.
3) Develop business plan materials including potential pilot programs